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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/634,086	08/04/2003	Yin-Shen Chu	67,200-1146	6692

7590 02/01/2005  
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EXAMINER

BLUM, DAVID S

ART UNIT PAPER NUMBER

2813

DATE MAILED: 02/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/634,086

Applicant(s)

CHU ET AL.

Examiner

David S. Blum

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

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This action is in response to the application filed 08/04/03.

## **DETAILED ACTION**

### ***Claim Rejections - 35 USC § 112***

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 7 and 18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 7 and 18 recite "the plasma etch chemistry" in claims 1 and 12, but claims 1 and 12 recite a first and second etch chemistry, but claims 7 and 18 do not clarify which etch chemistry is referred to.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-4, 6-9, 12-15, and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US 2004/0192058A1) in view of Liu (US006613689B2).

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Chu teaches all of the positive steps of claims 1-4, 6-9, 12-15, and 17-19 except for a first etch chemistry with CO gas to increase the etch resistance of the photoresist.

Regarding claims 1 and 12, Chu teaches a semiconductor wafer (23) with a first opening through the dielectric layer (25, figure 2A), and an uppermost BARC layer (26). Chu refers to layer 26 as a DARC (dielectric ARC) rather than BARC, but the layer is silicon oxynitride (paragraph 0020) as in the instant application. Chu teaches treating the photoresist with CO gas to increase its etch resistance (paragraph 0026) followed by multiple etch steps (paragraph 0028).

Liu teaches plasma etching with CO in the etch chemistry to decrease the etching of the resist (column 6 lines 6-16 and 24 and column 8 lines 24-25) by inducing a polymeric cross-linking reactions in the photoresist (the resist being polymer and reacting with carbon, this is a polymeric cross-linking reaction (as in claim 12). Thus Liu teaches the photoresist can be CO treated and etched in one step, a single step being more economical.

Regarding claims 2 and 13, the first and second openings comprise one of damascene and dual damascene (paragraph 0002).

Regarding claims 3 and 14, the BARC layer is silicon oxynitride (paragraph 0020).

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Regarding claims 4 and 15, the resist is one of I-line novolak or DUV (paragraph 0022).

Regarding claims 6 and 17, based on substituting Co for O, and the various tables, Liu is suggesting 3-5% CO, within the 3-20% recited in the claims.

Regarding claims 7 and 18, Liu teaches the plasma consists of one of a hydrofluorocarbon and a fluorocarbon (Liu teaches C<sub>4</sub>F<sub>6</sub> a fluorocarbon, an inert gas (Ar) and CO (see tables).

Regarding claim 8, Liu teaches a pressure of 40 millitorr (table 1) and RF power of 1500, teaching the higher RF power increases oxide etching, suggesting a lower PF power may be used.

These ranges are considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* (105 USPQ233), the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

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In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of etching regarding temperature, soak times, cooling rates, rate flows and concentrations using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the damascene structure desired to the parameters desired.

The flow rate is up to 5% as taught in the tables of Liu.

Regarding claims 9 and 19, Chu teaches patterning the photoresist comprises one of UV treatment and post development baking (paragraph 0022).

Regarding claims 11 and 20, Liu teaches this process for high aspect ratios and maintaining the high aspect ratio hole. thus a very low taper is suggested. the values of 0.2 and 2 degrees recited in the claims is therefore one of optimization as recited above.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Chu by CO treating and etching in the same step as taught by Liu, a single step being more economical.

5. Claims 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu (US 2004/0192058A1) in view of Liu (US006613689B2) and in further view of Tsai (US 006787445).

Chu and Liu teach all of the positive steps of claims 5 as recited above in regard to claims 1 and 12, except for the photoresist being an acrylic and for ashing of the resist.

Regarding claims 5 and 16, Chu teaches an I-line novolak photoresist. The instant specification teaches an I-line novolak resin or an acrylic based photoresist, with no criticality between the two. Tsai teaches both an I-line novolak resin or an acrylic based photoresist (column 4 lines 40-63), giving them an art recognized equivalence.

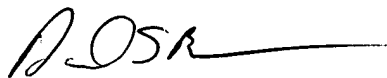
Regarding claim 10, Tsai teaches ashing in CF<sub>4</sub> and oxygen to remove the photoresist layer (column 5 lines 62-66) to remove photoresist after it is no longer needed.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Chu and Liu by including an acrylic photoresist as taught by Tsai to have an art recognized equivalence to usage of a novolak resist, and to remove the resist by ashing as taught by Tsai to be conventional practice.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



David S. Blum

January 31, 2005